STATIONERY DECODER COMPARISON

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DCC brings the ability to control many different parts of your layout through a single control system. A stationary decoder is similar to the decoder used in your locomotive except that it is optimized to control items that are usually fixed in position on your layout such as switch machines, signals, crossing gates, turntable motors, etc. While locomotive decoders typically have a single address, stationary decoders will allow you to individually address up to four separate items at four separate addresses through the same decoder. For example, section one of the decoder might control a switch machine, while section two controls an overhead signal. Section three could start and stop an action accessory such as some of the motorized carnival rides, while section four could provide all of the functions needed to animate a grade crossing. The possibilities are limited only by your imagination.

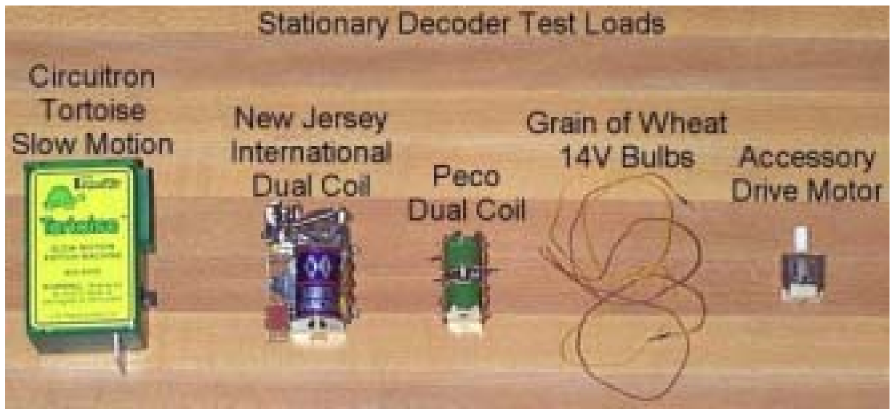
In this article, eight stationary decoders are compared. They are:

- Digitrax DS44 Quad Stationary Decoder
- Digitrax DS54 Quad Stationary Decoder
- Lenz LS100 Digital Plus Accessory Decoder
- North Coast Engineer Switch-It (also covered by an earlier Tony's article)
- Wangrow Electronic SM-104 Stationary Decoder
- EZ DCC low and high Amp stationary decoders (pending)
- Team Digital SMD 8

The table below gives a quick comparison of the various features and capabilities of the eight decoders. Interestingly, I found significant differences among the various models. To a large extent, your decoder selection should be based on your intended application. I found each decoder to be a **"Best Choice"** for certain functions, but none is **"one size fits all"**.

Summary of Recommendations - Detailed Analysis Follows

The **SMD8** is a solid addition to the growing body of DCC accessory decoders. If you use solenoid switch machines, I strongly recommend the SMD8 as possibly the preferred accessory decoder



for controlling your switches. If you are using either stall motor switch machines or solenoid switch machines in a complex yard or routing area, then the SMD8 is also an obvious choice, particularly with the ability to allow switch routing using fascia controls. While some DCC systems do have macro or switch routing capabilities, the SMD8 may find use even on these systems due to the ability to route switches directly from the fascia. Another potential benefit of the SMD8 is that the routes are stored locally in non-volatile memory. In some DCC systems, if the memory backup battery fails, you can loose all of your stored switch routes. The SMD8 prevents command station battery failure from erasing your switch routing.

The **DS54** is a **BEST CHOICE** for layout **automation**. If you want to set up a crossing gate tripped by a track detector or if you want to have your CTC signal system function automatically as the train enters a block, then the DS54 is the definite choice. If you already have a Digitrax system, the feedback capabilities of the DS54 will work seamlessly with your controller display to indicate switch

Decoder	Basic Data				Output Types Available			Programming Modes		
	Size (Inches)	MSRP	Address Range	Cab Bus Feedback	Variable Pulse	Cont.	Alternate Flash	Program Track	Operations	PR1
Digitrax DS44	1.63 X 0.69	$39.99	1 - ??	No	No	Yes	No	No	Address	No
Digitrax DS54	4.0 X 2.7	$79.99	1 - 396	Yes	Yes	Yes	Yes	Yes	Address	DS-54
EasyDCC	3.6 X 3.2	$34.95	1 - 2044	No	Yes	Yes	Yes	Yes	Yes	Fail
EasyDCC	3.6 X 3.2	$45.95	1 - 2044	No	Yes	Yes	Yes	Yes	Yes	Fail
Lenz	3.5 X 3.5	$79.00	1 - 1024	Yes	Yes	Yes	Yes	Yes	Address	Register
NCE	2.1 X 1.3	$24.95	1 - 2044	Requires AIU-01	No	Yes	No	No	Address	No
SMD 8	2.75 X 4.19	$89.95	1 - 2048	No	No	Yes	No	Yes	No	No
Wangrow	3.5 X 2.5	$75.00	1 - 2044	Requires AIU-01	Yes	Yes	No	Yes	No	No

position when you select a switch. The cascade capability will simplify setting up complex switch routes. It will work well with a Peco style snap action dual coil switch machine. The DS54 will easily operate incandescent lamps and LED's, but extra hardware is necessary to get adequate performance with a stall motor switch machine.

The **LS100** is a **BEST CHOICE** for **high current** switch machines such as the New Jersey International switch machine. If you are running G gauge with large switches and heavier duty switch motors, then the LS100 is probably your best choice. It will also perform well with dual coil switch machines such as the Peco. It is probably the poorest choice if your intention is to operate stall motor switch machines, since you not only need the LS100, but also four LA010 adapters for each LS100. For crossing lights and signals, it is equivalent to the DS54.

If your main application of a stationary decoder is to operate **stall motor** switch machines, the **Switch-It** is a **BEST CHOICE** for this application. It is easy to install, works well, and is the least expensive per switch point. It is functionally and programming compatible with all DCC systems that allow accessory control.

The **SM-104** is a **BEST CHOICE** for driving **auxiliary motors** such as found in accessories or turntables. This is the only unit that was able to operate my accessory motor, and it was able to operate it with authority. It is a next best choice for stall motor switch machines. It operates well with these units without external components and provides the convenience of four outputs in one location. It is, however, more expensive per output than the Switch-It and must be moved to the programming track to change the decoder address. If you are using dual coil switch machines such as the Peco, the SM-104 will work well with them.

In order to compare the various decoder functions, I selected an assortment of loads that would be representative of the kinds of functions that would be used on a typical layout. The first selection was a Circuitron Tortoise slow motion switch machine. This unit is designed to operate normally with the motor stalled at the end of the switch point movement in order to apply a positive holding force on the switch points. When running, the unit draws about 3 ma, and when stalled, it will draw a maximum of 25 ma. The Tortoise requires a continuous output whose polarity reverses direction in order to control it properly.

The second test load was a latching switch machine from New Jersey International. This is a particularly nasty load to drive because the coil resistance is only 1.9 ohms. At the normal track voltage for DCC, there could be a momentary current demand of over 6 amperes. Since the machine is a latching type, there is hysterisis in the mechanism that requires a significant force from the coil in order to kick the machine through its cycle. There are also auxiliary contacts that must be moved with the rest of the mechanism.

The third test load was a dual coil switch machine from Peco. This machine is typical of the type used on snap action switches. The coil resistance is 10.9 ohms, almost a factor of 10 large than the NJI switch machine. There is no auxiliary mechanism to move, so this machine draws about 1 ampere when activated.

The fourth load was a pair of grain-of-wheat lamps. These lamps are Model Power part number 252 and are rated at 14 volts. They draw about 30 ma at their rated voltage. I did not include light emitting diodes as part of my test since they draw about the same current as the grain-of-wheat lamps. In general, if a decoder works with the grain-of-wheat lamps, it will also work with an LED. Except in special cases, the LED will require a series resistor of about 470 ohms, and may require a series diode for cases where the decoder reverses the output polarity. (Note: although an LED is a diode, its reverse breakdown voltage is often on the order of only 5 volts. This means that if the reverse voltage is more than 5 volts, you also need a series diode to ensure that the LED does not conduct in the reverse direction. One way to solve this problem is to put two diodes in reverse parallel; this ensures that the reverse voltage on one is no more than the forward voltage of the other.)

The last test load that I used was a small DC motor. This motor is typical of the type that is found in motorized accessories. In fact, this particular one came from an IHC carousel motorizing kit. The motor has a DC resistance of 4.5 ohms, and draws 430 ma at 10.7 volts.

Stationary Decoder	Performance Rating with Test Loads				
	Tortoise	NJI Switch Machine	Peco Switch Machine	GOW Bulbs	Accessory Motor
Digitrax DS44 Quad Stationary Decoder	Recommend	No	No	Very Dim	No
Digitrax DS54 Quad Stationary Decoder	Very Slow	No	Yes	Yes	No
EasyDCC AD4KA Accessory Decoder	Recommend	No	No	Yes	No
EasyDCC AD4HA Accessory Decoder	No	Recommend	Yes	No	Pulse Only
Lenz LS100 Digital Plus	LA010 required	Recommend	Yes	Yes	LA010 required
North Coast Engineering Switch-It	Recommend	No	No	Very Dim	No
Team Digital SMD 8	Yes	Recommend	Recommend	No	No
Wangrow SM-104 Stationary Decoder for 4 Switches	Yes	No	Yes	Yes	Recommend

The table provides a quick overview of the test results. It is good for reference, but I strongly encourage you to read the detailed results. There are a number of subtleties that the table cannot cover.

My baseline layout system is the North Coast Engineering Powerhouse with the NCE ProCab. It is capable of supplying 5 amps to the rails, and is powered by the XFR 8 DCC Power Supply available through Tony's Train Exchange. Where required, I also used an MRC Tech II 2800 to supply AC or DC auxiliary power. Once programmed, all of the decoders operated on this system with no problems, a testament to NMRA standardization. Decoder programming, however, was a little more problematic. There are some incompatibilities, so read the programming remarks carefully. Enough background, let's bring in the contestants.

Team Digital SMD8 Eight Output Switch Machine Driver

General: The SMD8 is a stationary decoder optimized to drive solenoid and stall motor switch machines. It derives all of its operating power from the track eliminating the need for a separate power source. A voltage doubler is used to charge a capacitive discharge circuit for operating solenoid switch machines. Stall motor machines are run from a separate internal power supply. Since the outputs are programmable as to switch machine type, stall motor and solenoid switch machines may be mixed together as desired.

The unit will operate up to 8 switch machines with each machine assigned a unique accessory address. The base address of the unit can be anywhere from 1 to 2041. The base address is the address of the first switch machine driver output, while the remaining driver outputs are the next seven sequential addresses. There are provisions for four fascia mount pushbutton switches for local control of the unit.

The feature of the SMD8 that makes it well worth considering is its ability to set up switch routes using the eight switches connected to it. It can be programmed with up to 16 separate switch routes, with each route composed of up to 8 switches and an associated switch position. Each route can be accessed by a single accessory address and a CLOSE or THROW command. This feature makes the unit especially useful for yard areas or other locations that require complex switch position set ups.

Each of the fascia switches can also be set to control a switch route. Again, each route can consist of up to eight switches. Since the fascia controlled routes need not be the same as any of the DCC (remote) controlled routes, the unit can control up to 20 different switch routings.

Connections: The SMD8 is very easy to connect. There is a single two terminal euro style terminal block for connection of power from the track or from a track feeder. The remainder of the connections are via RJ12 plugs and jacks. The unit has four RJ12 jacks used for switch machine connection. Each jack has the connections for two switch machines. If the machine is a solenoid type, then three connections are made: Common, Throw, and Close. If the machine is a stall motor type, then only two connections are made: Throw and Close.

A fifth RJ12 jack provides connections for the four fascia mounted manual switches. There is a common ground for all switches and then a separate control wire for each switch. These switches should be normally open momentary pushbuttons.

A second two terminal euro style terminal block provides a connecting point for the jumper wire required during programming operations.

Feedback: There is no provision for switch position feedback to the cab bus.

Programming: Programming is the most complex operation on the SMD8. The unit can only be programmed on the program track and is programmed by setting various values into the appropriate CV locations. There are a fair number of CV's to be programmed, especially if you are using the routing feature, and it is easy to get confused. Further, there is no readback ability provided, so you can't read what value is in a CV, you can only set it to the value you desire. For this reason, it is probably a good idea to go through the programming instructions and write down the CV and its associated value on a list before you start programming.

The programming mode is entered by installing a jumper on the programming connector and connecting the unit to the programming track. Set your system to program CV values. When the unit is in the programming mode, a red LED is on continously. Every time a CV value is successfully written, a green LED flashes momentarily.

To leave the programming mode, turn off the programming track power and remove the programming jumper. Reconnect the unit to the layout track or DCC feeder. The next time power comes on, the unit will operate in its normal switch control mode.

During programming, you must program CV1 and CV9. These locations establish the base address of the SMD8. You must also program each of eight CV's (one for each output) to establish whether the output is driving a solenoid (three wire CD drive) or a stall motor (two wire reversing drive). If you are only going to address switch machines individually, then these ten CV values are all that you need to do. Route programming gets a little more complex.

First, you must program a route address. This is basically an alias address that looks to the DCC system as if it were a single switch, but in reality it is the address of an entire route. When you access the route address, a Throw command from your cab will cause one route to activate, while a Close command from the cab will activate a different route. Thus, once you establish the base address, the next four addresses combined with Throw and Close commands provide access to eight different routes. CV25 and CV26 are set to base addresses that provide access to a total of sixteen different routes.

Next, for each route, you must tell the SMD8 which switches are in that route and what the position of each switch is for the desired route. Thus, for each of the 16 remote routes and 4 manual routes there are two CV values to program (total of up to 40 CV values). If you don't need all 20 routes, it is OK to leave some of the CV's at their default value of 0, which disables switch selection and position for the associated route.

Manual: The manual is a single page, printed double sided and folded. It does contain all of the information you need to operate the SMD8, but you will probably need to read through several times to figure out all of the details. The discussion above will hopefully help you work your way through the manual the first time.

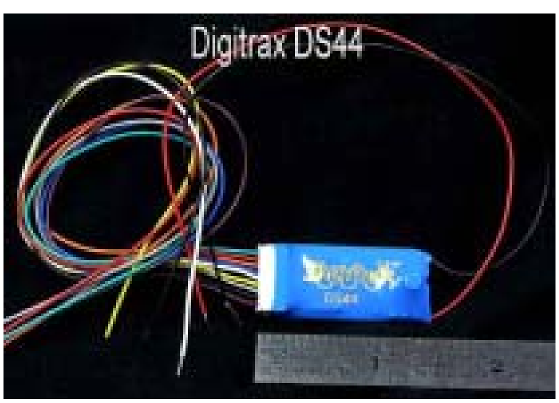
Performance: In a word: EXCELLENT! I measured 25.8 volts on the capacitive discharge storage capacitor. Not surprisingly, this resulted in very solid performance of the NJI switch machines that I used in my test. These are large and include auxillary contacts, so take a fair amount of energy to operate. The SMD8 had NO problem operating these units. My guess is that if the SMD8 can operate these units, it will have no trouble with anything on your layout.

I was a little disappointed with the performance on stall motor switch machines. The unit was competent, but the stall motors were a little sluggish. I measured 9.1 run volts at 3.0mA and 4.9 stall volts at 7.1mA. The run voltage is below that found in some other accessory decoders, but does provide acceptable stall motor performance.

The unit will run lamps and LED's in the stall motor configuration, but an external power source is required for this. For this reason, other decoders are probably more appropriate if you are driving lights.

Similarly, there is no provision to provide motor on/off control, so my accessory motor was not compatible.

As part of my test, I set up a four switch route with two NJI solenoid switch machines and two Tortoise stall motor switch machines. The route feature worked very nicely. Since the unit uses a CD drive for the solenoid machines, it needs to recharge after each solenoid throw. The SMD8 has built in sequencing to allow the CD system to recharge after each solenoid operation. The delay between throws is about 2 seconds. Thus, when I triggered a route, NJI machine 1 would operate, followed by a 2 second wait, then NJI machine 2 would operate and then the two Tortoise machines would operate. The whole sequence triggered by a single accessory Throw or Close command. Very nice!



Digitrax DS44

General: The DS44 is the Digitrax equivalent of the North Coast Engineering Switch-It. It is designed specifically to operate stall motor switch machines and will not work with most other types of accessories due to a limited current drive capability. The DS44 is easily the smallest stationary decoder of the group. It consists of a 0.6875" X 1.625" surface mount circuit board with approximately 7" wire leads. The wires intended for connection to the switch motors are together in a harness that plugs into the circuit card. The plug/socket arrangement is the same one that Digitrax uses on some of its engine decoders. The two wires intended to connect the unit to the track power (Red and Black) are hard wired to the circuit card.

The DS44 allows the control of up to four stall motor switch machines. Unlike some of the other stationary decoders, however, there is no provision for manual control of the switch motors, and there is no way to restore factory default addresses should you end up loosing you secret address decoder ring.

Connections: All connections to the unit are via the included 7" wire harness. On a practical basis, it is unlikely that you will have four switch motors within 14" of each other. You will likely have to either extended the length of the wires by splicing or connect the unit to a terminal block to allow longer wire connections.

Feedback: There is no provision for switch position feedback to the cab bus.

Programming: Programming can be done in the block mode or the random address mode.

In the block mode, addresses are assumed to be sequential in blocks of four. Thus, 1-4 is one block, the next is 5-8, and so on. A table of block addresses is included in the instructions. To program in the block mode, find the White wire in the switch motor harness. Connect the White wire to the Black track power wire and turn on track power. Choose the block you want to use, and use your throttle to send any one of the addresses in the block. The DS44 will be programmed to the selected block. The A output will be the first address, the B output the second, etc. Once programmed, remove the White wire and carefully stow it so that it will not contact any of the other wires.

If you want to program the unit in the random address mode, connect the White wire in the switch motor harness to the Red track power wire and turn on the track power. Use your throttle to access the four addresses you want to use. The first address sent by the throttle will be the A output address, the second will be the B output, and so forth. In this way, you can assign each decoder output to any accessory address that you desire. Once programmed, remove the White wire and carefully stow it so that it will not contact any of the other wires.

Manual: The manual consists of a double-sided printed card included with the decoder. It is adequate to allow connection and operation of the DS44, but is lacking in all but the most basic information.

Performance: The DS44 performed its intended function quite well. The stall motor switch machine ran at normal speed with good torque for moving reticent switches. The run voltage was 10.6 volts, while the stall voltage was 9.8 volts. Both of these values are quite sufficient to ensure proper operation of stall motor switch machines. The measured run current was 2.4mA while the stall current was 13.9mA. These values are sufficient to allow the use of an LED in series with the switch motor to indicate switch position. I used a red/green dual LED in my testing, and both red and green were bright and easily visible. (If you are unfamiliar with a dual LED, they are designed to illuminate one color when the current flows through in one direction, and a different color when current flows in the opposite direction. Since current through the switch machine is in opposite directions for the two positions, a dual LED can be used to indicate the position of the switch machine.)

I also tested the DS44 using a 470 ohm ¼ watt resistor in series with an LED. The LED was bright and drew approximately 16.7mA. Based on this test, the DS44 could be used to control signal lights if LED's are used in the signaling system. Since the unit is physically small, another application possibility is to control interior, marker, and drumhead lighting in your passenger cars. All of these lights must be LED's since the DS44 does not have sufficient current/voltage capability to operate incandescent lamps. With the four sections, a separate address could be assigned to each of the lighting circuits.

Recommendation: The DS44 performs its intended function quite well. At an MSRP of approximately $10 per switch motor, it is quite cost effective. When comparing to other stationary decoders, you must decide if the lack of manual controls and lack of direct terminal block connections is an acceptable trade-off for lower cost per switch.

Product Comparison: The Digitrax DS44 is designed as a direct competitor of the NCE Switch-It, so I did some additional testing to directly compare the capabilities of the two devices. The first note of interest is that the DS44 and the NCE Switch-It use the same microprocessor (MicroChip 12CE519) and output driver (LM324). Switch-It has one LM324 to drive two switch motors, while the DS44 has two LM324 to drive four switch motors. Since the basic stationary decoder consists of a microprocessor (to receive and decode the DCC packets) and a switch motor driver (to supply operating and stall current to the switch motor), it would appear that the DS44 and Switch-It are identical. Performance measurements indicate that this is not true, and that the Switch-It is the superior performer.

For this series of tests, I used a Digitrax DCS 100 and selected "N", "HO", or "O/G" track voltage as required.

For the first test, I used resistive loads to simulate various current conditions, and measured the temperature of the driver package for a single loaded output. Based on the measured temperature rise, I calculated the case temperature of the driver for both outputs loaded to the same current value. The results are shown below:

Unit Tested	Scale Setting	Load (ohms)	Volts Out	MA Current	Case Deg C
DS44	HO	470	9.33	19.9	45.4
	HO	260	7.32	28.2	58.8
	O/G	600	8.7	14.5	87.6
	O/G	**260**	**4.41**	**17.0**	**105.6**
Switch-It	HO	470	9.41	20.0	35.2
	HO	260	7.18	27.6	44.6
	O/G	600	13.93	23.2	39.8
	O/G	260	8.76	33.7	58.6

Temperatures are given in degrees Celsius. Remember that 100 degrees Celsius is the boiling point of water. The maximum chip die temperature is specified at 125 degrees Celsius. The condition marked in red for the DS44 will definitely have a die temperature in excess of the maximum allowable, while the condition above it at 87.6 degrees case temperature may exceed the maximum allowable die temperature. All conditions for the Switch-It are within the maximum allowable power dissipation and die temperature for the LM324. A word of caution, however: 58.6 degrees Celsius will feel VERY hot to the touch, possibly hot enough to cause a burn.

As a follow up test, I connected each decoder to a Tortoise switch machine and tried operating the machine on each scale setting. I got the following results:

Unit Tested	Scale Setting	Response
DS44	N	Slow
	HO	OK
	O/G	**Fast with Oscillations**
Switch-It	N	Adequate
	HO	OK
	O/G	Fast with One Overshoot

On the N setting, both units were slow, but the Switch-It was slightly better. Both worked fine on the HO setting. On O/G, both units ran faster than you would like for a slow motion machine, but the DS44 exhibited another problem. It would run hard into the end stop, the output drive would crash so that the Tortoise bounced off the end stop and back the way it had come, the output drive would pop back up, and the Tortoise would run hard into the stop again. It continued this oscillation for as long as track power was applied. This would be unacceptable operation if the unit were in control of switch points. In contrast, the Switch-It ran hard into the stop, bounced back a small amount, and then settled into stable locked stall position.

Finally, I left each unit attached to the Tortoise in the stall position (for the DS44, I ran it to stall on "HO" and then changed the scale setting to "O/G") and monitored the driver chip case temperature. The results are shown below:

Unit Tested	Scale Setting	Current (ma)	Case deg C
DS44	HO	13.98	32.9
	O	**18.2**	**50 (Runaway)**
Switch-It	HO	13.50	28.7
	O	20.68	31.3

In this test, I reported the case temperature for just one active output. The DS44 went into thermal runaway. I stopped that test after the temperature passed 50 degrees Celsius and was still climbing. Two active outputs at this point would have had the die close to its maximum allowed temperature. Thermal runaway is a condition in which the output current heats up the die, and as the die gets hotter, the current output increases, which increases the temperature, etc. The die temperature continues to increase until the unit is destroyed.

Based on the data above, it appears that the DS44 should not be used with the scale set to "O/G". It appears to work acceptably well on "N" and "HO". The Switch-It can be used on any scale setting with no problems. It also appears that the Switch-It will generally run cooler than the DS44, all other conditions being equal. Temperature is the bane of semiconductor devices. Their failure rate increases as the cube (third power) of the temperature increase. Keeping things cooler will result in more reliable operation (i.e. fewer decoder failures).

Digitrax DS54 Quad Stationary Decoder for Digital Command Control with Programmable LocoNet Input/ Output

General: The Digitrax DS54 is the most comprehensive decoder of the group. It has more options than any of the others, and has the capability to do some stunning layout effects, such as complete operation of a crossing gate. It has feedback to the LocoNet cab bus that carries position data, and has the capability to accept multiple trigger inputs from track detectors, push buttons, etc.

There are four independently programmable outputs arranged in decreasing successive address order from four times the baseline address of the decoder. Each output has a green common with a black and a yellow signal output. Each output can be set to one of four modes.

Retriggerable pulse of programmable length
Non-retriggerable pulse of programmable length
Continuous output
Blinking

Retriggerable and non-retriggerable pulses are the same except that the retriggerable can be lengthened if another trigger occurs before the pulse is finished, while the non-retriggerable cannot be extended. The pulse output will appear between green and black or green and yellow depending on the whether an ON or OFF signal is sent to the decoder. The pulse mode is used generally to control a twin coil switch machine such as the Peco. Green goes to the common, yellow goes to one coil, and black goes to the other coil. If the switch works backwards, then reverse black and yellow. The pulse is set to the shortest pulse that will throw the switch machine.

In the continuous mode, the output is always on. It is on from green to black for one command, and is on from green to yellow for the other command. It is kind of on from yellow to black or from black to yellow, changing polarity with the input command (see below under performance). The continuous mode is for stall current switch machines and similar types of loads.

Finally, there is the blinking mode. In this mode, black to green is on and yellow to green is off in one time period, then they switch with yellow to green on and black to green off. The on and off time are equal, but the length of time is programmable. An off command has everything off. An on command starts the blinking. This mode is used to operate a crossing flasher with alternating flashing lights.

The DS54 has 8 trigger inputs that can be programmed to perform various tasks. A trigger input detects when a particular action has occurred (such as the locomotive entering a block) and causes some other action to occur (such as causing the output connected to a signal to switch from green to red). The inputs can be set to respond either to a constant voltage level or to respond to a changing voltage level, depending on the desired function. The relationship between the inputs and outputs is completely controlled by the values programmed into the unit's Configuration Variables (CV's).

Connections: Input connections for triggering functions are via a standard Digitrax 9-pin connector. Outputs are connected to loads by a four-wire standard telephone type connector (red, black, yellow, green). You can go to the hardware store, by one cable, cut it in half, and you have two output cables. Both input and output cables and connectors are included with the DS54. Track connections are by two #6-32 screw terminals. The interface to the LocoNet is a standard RJ12 connection. The auxiliary AC power connections are made to a red/black wire lead pair that comes already soldered to the printed wiring board.

Feedback: All of the functions listed above will work with any DCC system (assuming you can get things programmed). If your DCC system is Digitrax with LocoNet, then there are additional functions available. These are feedback functions, and they allow the command station to receive information from the decoder and allow the decoder to issue commands on the cab bus in the same way as the cab itself. One type of information is turnout position. By feeding position feedback to the command station, the cab can display the turnout position on its display. Another example actually allows one switch to control the position of another switch. In this case, when you throw switch #1 on your layout, the decoder at the switch #1 address can contain directions that will send a message to the control station to also throw switch #2. Switch #2 can contain instructions for switch #3, and etc. In this manner, a single action can be cascaded. In the example, it may line up a particular switch route. As another example, a switch can be wired to a trigger input on the decoder, and programmed to issue a RUN/ STOP command to the layout based on switch status. There are also commands for the control of a self-indexing turntable, and for the linking of signals in a CTC setup. This discussion is not exhaustive, but should give you a good idea of the capabilities of the DS54.

Programming: The first thing to remember about programming the DS54 is that all the variables are hexadecimal numbers. These are numbers based on 16 instead of 10. The manual contains a conversion chart, but you must pay attention to the values that you are entering.

Any DCC system that has accessory access can program the base address of the DS54. The address button on the unit is pressed and then a switch command within the desired address is sent. The unit will set the decoder addresses based on this data. For all other programming, either a Digitrax system must be used or you can use the Digitrax PR1 programmer (review of the PR1 is also available on Tony's site). I tried programming the DS54 with my NCE system. On the programming track, the NCE system could not read the CV data. When I programmed the CV data and then read it back using the PR1, it did not appear that the correct data had been stored. The NCE system did, however, correctly modify the base address of the unit as described above.

On the DS54 printed wiring board are two link pins. These pins must be linked in order to program any CV, and must be unlinked for normal operation. Programming must take place on the programming track, and must be done with no loads, inputs, etc. connected to the unit (an exception is the special load used to allow CV read back). Programming the DS54 can be a daunting task, particularly since you need to keep track of all your options as digital numbers. I found that the PR1 made programming the DS54 much easier. The PR1 has a special programmer function for the DS54. All the options are available through drop down boxes that allow you to select the exact options that you want. Once you have set things up, a simple SEND will correctly program a DS54. The PR1 also allows you to read back the programmed data. If you forgot how you set up a particular unit, the PR1 lets you quickly determine what you did rather than sorting through hexadecimal numbers CV by CV. If you are going to use the DS54, I strongly recommend the use of a PR1 programmer.

Manual: The manual for the DS54 is well done and complete. Since the unit itself is quite complex, the manual also contains a lot of information. I recommend several reads through the manual before you touch hardware. The manual is very good at taking you step by step through the DS54 from simple to more complex functions. Throughout the manual are very clear hookup drawings and step-by-step programming instructions. Once you have digested the manual, you will have a very good working knowledge of the DS54.

Performance: The DS54 has two input terminals for auxiliary AC input. If no AC is supplied, the accessories are powered by the track DCC. I tested things both with and without auxiliary power.

Surprisingly, the first load that the DS54 had trouble with was the Tortoise slow motion switch machine. The manual does mention that this is a problem. With the selected output set to continuous and the Tortoise connected from black to yellow, the Tortoise ran, but VERY slowly with very little torque. The run voltage was 6.1 volts, while the stall voltage was 3.1 volts. This was very marginal operation at best. As recommended by the manual, I connected a 470 ohm resistor from yellow to green and from black to green. Now the Tortoise ran much better! I measured 10.5 volts run and 7.4 volts stall. Not quite the desired stall torque, but certainly acceptable. I tried the Tortoise without the resistors but with external 15.1 volts AC power. Again, the unit ran acceptably well. I measured 12.7 volts run, but only 5.0 volts stall, so the stall torque in this configuration is still not very good. It seems that external components are required to make the DS54 work with stall motor switch machines. This requires a more complex installation. I wondered if I could limit the liability a little by combining functions. The 470 ohm resistors supply about the same current as the grain-of-wheat bulbs, so I connected one bulb from green to yellow and one bulb from green to black. That worked quite well. Now I got 11.4 volts run and 9.2 volts stall, about where it should be. In addition, the lights acted as a position indicator, alternately lighting as the switch changed position. The lamps had 11.4 volts across them when active in this configuration. I believe this is the best configuration to use if you are using the DS54 with a stall motor switch machine such as the Tortoise.

I could not get the DS54 to operate the New Jersey International switch machine. I tried DCC and auxiliary AC power, and I lengthened the pulse to 4 seconds. The best I could get was a subdued buzzing noise.

The Peco switch machine worked fine with both DCC and auxiliary AC power. I used a 0.5 second pulse, and it was more than sufficient. It may depend on the specifics of the switch to which the machine is connected, so you may have to adjust the pulse width a little with your setup. I noticed that the Peco worked with significantly more force when I used external power. The source voltage goes from about 11.6 volts on DCC to about 19.3 volts on my 15.1volt AC source. The higher voltage gives more magnetic force and snappier switch operation.

I wired the grain-of-wheat bulbs both with one lead to green. On one lamp the other lead went to yellow. The remaining lead went to black. If I programmed the CV to one of the blinking rates, the bulbs alternately flashed, as in a crossing signal. The flashing could be turned on and off by DCC command. When I programmed the CV to constant, then I could turn on one lamp or the other in succession. In other words, this mode is used to control a two-lamp signal. When I ran the lamps from DCC power, the voltages were just about right: 11.4 volts. Slightly under powering an incandescent lamp will result in greatly extended life. However, when I used my 15.1 volts AC auxiliary power, I found that the lamp voltage had increased to 19.3 volts. This voltage is much too high for these lamps! They look very bright, but they will die within hours. If you are going to use external power with the DS54, either decrease the AC voltage (which will reduce the effectiveness with switch machines, etc.) or use higher voltage lamps in your lighting circuits. A third alternative would be to include a series resistor sized to drop the lamp voltage to the correct range. A final solution is to use a red, green, or white LED for the lighting effects and size the series resistor to give the correct LED current with the actual DS54 output voltage. To calculate the resistor size, divide the output voltage in the lamp mode by 0.025. This will give you the minimum resistor value in ohms that you can use. Up to 25% larger in value is probably OK.

I was unable to get the accessory motor to operate with either DCC power or auxiliary AC power. I measured only 9.6 ma at less than 1 volt across the motor.

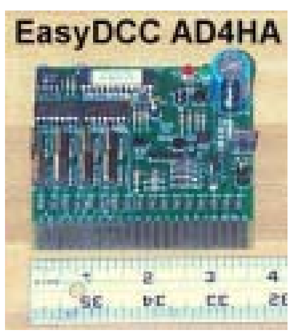
Recommendation: The DS54 is a **BEST CHOICE** for layout automation. If you want to set up a crossing gate tripped by a track detector or if you want to have your CTC signal system function automatically as the train enters a block, then the DS54 is the definite choice. If you already have a Digitrax system, the feedback capabilities of the DS54 will work seamlessly with your controller display to indicate switch position when you select a switch. The cascade capability will simplify setting up complex switch routes. It will work well with a Peco style snap action dual coil switch machine. The DS54 will easily operate incandescent lamps and LED's, but extra hardware is necessary to get adequate performance with a stall motor switch machine.

EasyDCC AD4 Series Accessory Decoders

General: EasyDCC started as a series of how to articles in Model Railroader magazine. As a result of this heritage, there is a lot of documentation of their products in back issues of MR, and you can purchase their products as either completed units of a parts kit for self assembly. Clearly, the self-assembly approach results in significant cost savings if you don't charge yourself by the hour on weekends and evenings. I was provided with two completed units, the AD4KA and the AD4HA.

These decoders are essentially the same unit, with the AD4KA optimized for stall motor switch machines and the AD4HA optimized for dual coil switch machines. The difference is that the AD4HA has its drivers jumpered directly to the output terminals, and can drive a maximum of 50 ma. This configuration is optimized to drive stall motor switch machines. The AD4KA has power transistors after the output drivers for increased current capability, and it has a built in capacitive discharge unit to ensure solid operation of dual coil switch machines. Both units use the same printed wiring board, and changes are made by selecting which parts are populated or not populated. Because of the way that the circuit is designed, a stall motor output will not work with a dual coil machine, and the unit configured for dual coil will not work with a stall motor switch machine. Since the same printed wiring board is used for both versions, all four outputs are configurable by changing hardware. If you start with an AD4HA and remove its output transistors and add two jumpers, you have a stall motor output. If you have an AD4KA and you remove two jumpers and add driver transistors you have a dual coil driver. In this case, you would also have to add some parts for the capacitive discharge unit, so if you are mixing outputs, it is probably better to start with the AD4HA.

When used for stall motor switch machines, the power to operate the switch machine comes from the track power or a dedicated DCC booster. For the dual coil switch machines, a separate AC power source is required to charge the capacitor in the capacitive discharge unit. The AC source can be the accessory output of an old power pack or a dedicated transformer such as the XFR4 from TTE. The transformer does not require a large current output since it is only used to charge the capacitive discharge unit, it does not power the dual coil switch machine directly. You can customize the power source in terms of voltage and current to optimize switch machine response and recharge time. I used an XFR8 from TTE to do my testing, although the 8 amp capacity is not required. Although the 2200uF capacitor supplied with the dual coil unit appears to be adequate, there is a provision for adding additional capacitance to increase the discharge capability.



The AD4 series provides four inputs for use with momentary push buttons. These inputs allow local manual operation of the decoder outputs. A unique feature of these inputs is that they can be locked out by writing the appropriate data to CV 514. The CV write can be done directly on the main. Thus, a dispatcher can lock out manual control of the decoders during a particular operation, and then restore manual capability once the operation is complete.

Connections: Connections to the AD4 series decoders are a little more difficult to do than with other decoders. The basic board has card edge fingers designed to mate with a card edge connector such as Mouser Electronics part number 15PC005. A second alternative is to solder in a screw terminal connector strip, also purchased separately. If you are really good, (and really lucky) holes are provided so that you can directly solder wiring to the printed wiring board.

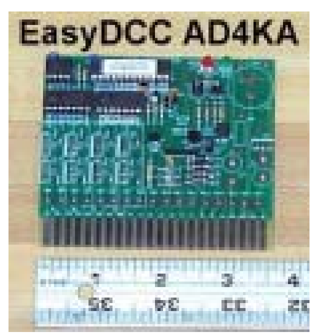
Feedback: There is no provision for feedback to the cab bus. This must be provided by a separate unit.

Programming: Programming the AD4 series of decoders is very easy. I first used the programming track. My NCE system was able to read and write to all the required CV locations. I was also able to write to the units while connected to the main tracks. Using the Program Accessory mode of my NCE system, I could write (but not read) each CV while the unit was installed on the layout. This is handy if you need to modify the configuration after the unit is installed. The AD4 series also has a broadcast feature. By writing to a CV at address 511, the data are written to the specified CV of all AD4 series decoders. Thus, with a single write, all of the manual inputs to all decoders could be locked. Later, a single write to CV 514 of address 511 could re-enable all manual inputs.

I tried unsuccessfully to program the AD4 units with the PR1 programmer. The PR1 does have a programming module for the AD4 series, but I was unable to get it to either read or write address or configuration data.

Manual: The manual is not supplied with the units. It is available by download from the EasyDCC site at http://www.cvpusa.com/. The manual is well written and provides all the information necessary to get the decoders up and running. It has examples of mixed configurations, shows various wiring strategies, has an example of how to build a card cage for multiple units, and in general is an excellent resource for installing and operating the decoders.

Performance: I tested the AD4KA with the Tortoise stall motor switch machine and the grain-of-wheat bulbs without external power (power supplied by track DCC). The Tortoise ran very well. I measured 9.9 volts stall and 10.8 volts running. These values will provide top performance out of the Tortoise.



The grain-of-wheat bulbs were tested in the flashing mode, such as would be used for a crossing guard. The flashing worked well with about 10.5 volts on the bulb, and could be programmed from 0.1 to 12.7 seconds per flash. One to two seconds actually looks best. One minor problem that turned up, the flashing turned ON when my NCE system said I was turning the accessory OFF, and turned OFF when the controller ordered it ON. Although backwards, this is a minor problem.

To test the dual coil machines, I switched to the AD4HA. This decoder is the only unit that I tested other than the Lenz that was able to operate the New Jersey International dual coil machine. It operated the NJI unit with AUTHORITY! Action was solid and repeatable in both directions with excellent force for moving mechanical systems. This performance is a result of incorporating a capacitive discharge unit directly into the decoder along with high current output transistors. The capacitor voltage measured 25.0 volts using my XFR8 18VAC supply. The short term current into the NJI switch machine would be in excess of 12 amps. This high current pulse ensures proper switch machine operation. The capacitor discharges quickly, so there is no chance of burning the switching coil from too long an operating pulse. Since the AD4HA was able to operate the NJI dual coil machine, it had no trouble at all operating the Peco dual coil unit. Again, the operation was solid and reliable with excellent throw force. Both of these tests were done with a 0.2 second pulse. Difficult loads could go to a wider pulse width. Remember that the energy comes from the capacitor, and once it is discharged, increasing the pulse width will not increase energy to the load.

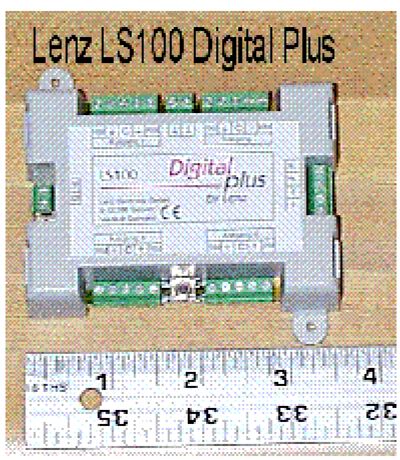
I tried the AD4HA with the accessory motor. It really is not designed to run this type of motor. There is no way to connect the motor to reverse, so an external reversing switch is necessary if you need to run in more than one direction. I was able to run the motor in pulses of about one second. This was about the time it took the motor to discharge the capacitor and then coast to a stop. This might be useful in an accessory that only needed a short burst of rotation, such as a coal loader, to release the rest of the mechanism.

The AD4HA will drive a lamp that draws more current than the grain-of-wheat bulbs that I used. Be careful since the bulb will be subjected to the full charge voltage of the capacitive discharge unit.

Recommendation: I found the AD4 series of decoders to be well designed and to operate well with their designated loads. The AD4 decoders are a Best Choice for layouts with mixed stall motor and dual coil switches since the outputs can be customized switch by switch. It is also a serious contender for layouts that use bi-stable switch machines such as the New Jersey International unit. Its performance is equal to the Switch-It, and would be useful where four switches are in close proximity. If you are not put off by doing your own assembly, the AD4 series of decoders has the potential of providing the lowest cost per switch of all of the stationary decoders tested. The fully assembled units are also quite cost competitive.

Lenz LS100 Digital Plus Accessory DCC Decoder

General: The Lenz LS100 Digital Plus decoder certainly had the neatest packaging. As you can see from the photo, the entire circuit card is encased in an attractive and protective plastic case. The LS100 is similar to the Digitrax DS54 except that it does not have the trigger input capability. There are four outputs, each one individually addressable and programmable. Each output can be programmed to output a pulse of programmable duration, a constant output, or an alternating flashing of programmable flash length (e.g. a crossing signal). Each output is configured with a common and a positive and negative terminal. This configuration is optimized for dual coil switch machines where the common connects to the common of the switch machine, the positive connects to the other end of one coil, and the negative connects to the remaining coil lead. In fact, a separate accessory, the LA010 adapter is require in order to operate a stall motor switch machine or an accessory motor.



In addition to track connections, there is an input for auxiliary power. In order for the LS100 to operate, the auxiliary power input must be connected to something. You can either wire it in parallel with the track wires to run the LS100 off of track power, or connect it to an auxiliary AC power source.

Connections: All connections to the LS100 are made by screw clamp terminal strips. Connections may be made with standard hookup wire.

Feedback: The LS100 is capable of providing position feedback. In order for this function to work, you must have the Lenz LZ100 command station. Each output has two extra connections. When these connections are wired to the non-common side of the outputs, they provide feedback to the command station that identifies the position of the output.

Programming: The LS100 has some nice programming features. There is a red LED on the circuit card that lets you know when the LS100 is receiving DCC data. Next to the LED is a push button. If you hopelessly mis-program the LS100, you can push and hold the push button until the LED goes through several flashing cycles. Once the LED stops flashing, you can release the push button, and the LS100 is programmed to factory defaults, allowing a graceful recovery from any conceivable programming error.

Address programming is easy. Simply depress the push button until the LED illuminates steadily and then release the button. The LED stays on. Send an accessory switch command to one of the four addresses in the group of four that you want to use (remember addresses are only in groups of 4), and the LS100 will program itself to the new address group. This can be done while installed in the layout.

In order to program the outputs (pulse, constant, flashing), you must use register programming on the programming track. The instruction manual gives the register numbers and the values to be entered into the register for each function. These numbers are given as decimal values. Using my NCE Powerhouse system in the register programming mode, I was able to read and write register contents without any trouble. Note that the AC input terminals must be tied to the DCC track terminals for this to work. I tried the PR1 using the register programmer. The PR1 was not able to read the register contents. When I entered values into the register program field and pushed send, the data was correctly programmed. I confirmed this by reading the data that the PR1 had programmed with the NCE Powerhouse system on the program track. I also issued control commands from the command station and verified that the LS100 worked the way I had programmed it.

Manual: The manual is clear and well written. It contains all the data necessary to set up and operate your LS100. It is simple and easy to follow. Some of the wording is a little strange due to translation from German (you actually get the complete manual in German), but the intent is clear. Note that in German, Ausgang means exit or output. The four outputs are labeled Ausgang 1 through Ausgang 4.

Performance: The LS100 was the only decoder of the group that was able to operate the New Jersey International switch machine. It would not operate from DCC power, but when I connected the auxiliary power inputs to my 15.1 volts AC, the NJI unit worked like a champ. Obviously, since the NJI unit was not a challenge, the LS100 had no problem with the Peco dual coil switch machine. The Peco unit worked both from DCC power and from auxiliary power. The grain-of-wheat bulbs worked fine both in the flashing mode for crossing flashers or in the constant mode for signal lights. You can also use LED's for the lights with the appropriate dropping resistor (about 470 ohms for a 25 ma LED). The operating voltage with DCC power was 12.9 volts, while the measured voltage was 11.6 volts when operating from AC auxiliary power. This performance was better than the DS54 since the lamp voltage was much more constant with varying input voltage values. I was not able to operate the Tortoise or the accessory motor since I did not have an LA010 available. The LA010 converts the three wire dual coil switch machine outputs to the two wire reversing outputs needed to run the stall motor switch machines.

Recommendation: The LS100 is a **BEST CHOICE** for high current switch machines such as the New Jersey International switch machine. If you are running G gauge with large switches and heavier duty switch motors, then the LS100 is probably your best choice. It will also perform well with dual coil switch machines such as the Peco. It is probably the poorest choice if your intention is to operate stall motor switch machines, since you not only need the LS100, but also four LA010 adapters for each LS100. For crossing lights and signals, it is equivalent to the DS54.

North Coast Engineering Switch-It

General: The NCE Switch-It is a two-address decoder specifically designed to drive stall motor switch machines. It therefore does not have some of the features that the other decoders have. It is the easiest to install:

Connect two wires to the track
Connect two wires from Switch Machine 1 to Output 1
Connect two wires from Switch Machine 2 to Output 2
Use 3M double-sided tape to attach to the side of one of your switch machines

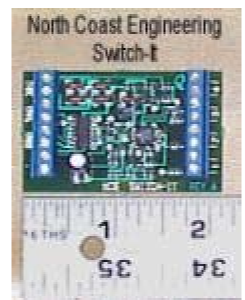
The Switch-It has a terminal block for manual input. If you wire four momentary push buttons to these terminals, the operation of the push buttons will provide manual operation of the switch in addition to DCC control.

Since the unit is designed for stall motor switch machines, its output current capability is limited to 50 ma, more than sufficient for the 25 ma stall current of the Tortoise. An added benefit is that since the switch machine limits the current to 25 ma, you can place LED's in series with the decoder output without the normal current limiting resistor. The switch machine itself acts as the current limiter.

Connections: Connections for the track, switch machines, and manual control switches are by screw clamp style terminal strips. You can use any general-purpose hookup wire to make connections to the Switch-It.

Feedback: The Switch-It has no provision for feedback to the cab bus. If you need switch position feed back, then you must wire the switch position data into an auxiliary cab bus input such as the NCE/Wangrow AIU-01.

Programming: Since the Switch-It only has one function, there is no programming other than to specify the address of the associated switch. The unit can be programmed by any DCC system that supports accessory control. This is done by connecting two wires across the manual switch inputs for the output to be programmed and issuing an accessory control command to the desired accessory address. Then remove the wires. You are ready to go. This method also works to recover the unit if you have hopelessly programmed the Switch-It to a secret address. If you have an NCE Powerhouse system, then programming the Switch-It is even easier. Set all decoder addresses within 4 of the current address (factory default 1 or 2) to OFF. Set the address to be programmed to a new value to ON. (This assumes you know the units current address. It comes defaulted to 1 and 2. If you have no clue as to the address, then use the jumper wire procedure.) Use the PROGRAM ACCESSORIES mode of the ProCab to set CV 545 (output A) or CV 546 (output B) to 1. Next hit SEL ACCY and enter the address you want the Switch-It to use and hit 0 or 1 when prompted. The unit is now programmed to the new address. You can re-assign Switch-It addresses in place on your layout as your layout changes or as operating considerations require.



Manual: The manual is clear and easy to follow. It contains all the information you need to get your Switch-It working.

Performance: I did not test the Switch-It with the high current loads because its output capability is limited to 50 ma. It did light the grain-of-wheat bulbs, but they were dim. I measured 23.8 ma instead of the more normal 30 ma.

The Switch-It works perfectly with the Tortoise switch machine. Run voltage is 9.8 – 10.5 volts when operating directly from track power (there is no provision for separate switch power input). Run current was 3.3 ma, and stall current was 13.6 ma. The Tortoise ran solidly with good torque. I tried putting a red/green dual LED in series with the Tortoise. It was bright red when running/stalled in one position and bright green when running/stalled in the other position. This gives a simple method of indicating point position on your control panel. If the LED where installed in a single lens target signal, it would make a perfect track side position indicator. Two LED's could be connected in series for dual indications with little effect on the Tortoise operation.

I replaced the Tortoise with a 470 ohm ½ watt resistor. The LED switched from red to green just as before. In this mode, you could make a dual lens signal with the Switch-It and be able to do all four color combinations (red over red, green over green, red over green and green over red) as are used in prototype signals. If you used a separate red and green LED, a standard two-color signal can be made.

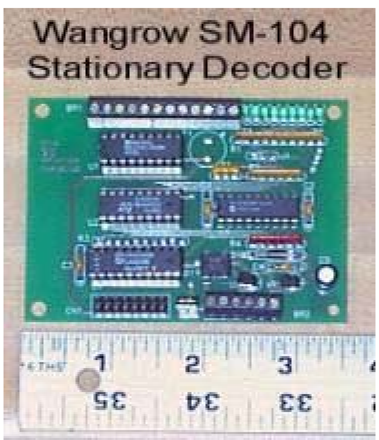
The Switch-It is the only decoder of the group that is small enough to fit inside of an HO boxcar. By filing the small tabs on either side of the printed circuit board, the card will just fit into a standard boxcar. With a flashing LED, this will make an End of Train device controllable from the command station. With a white LED, you can control the drumhead and tail light of a passenger car, in addition to the red and green marker lights. You could also control the marker lights on a caboose.

Recommendation: If your main application of a stationary decoder is to operate stall motor switch machines, the Switch-It is a **BEST CHOICE** for this application. It is easy to install, works well, and is the least expensive per switch point. It is functionally and programming compatible with all DCC systems that allow accessory control.

Wangrow SM-104 Stationary Decoder Set

General: The Wangrow SM-104 is a four-address decoder. Each of the four outputs can be programmed to a pulse of programmable length or a constant output. The pulsed outputs can be set to drive a dual coil switch machine, while the constant outputs can operate signal lights, a stall motor switch machine, or an accessory motor.

To operate a dual coil machine, the two ends of the coil are wired to the outputs, while the coil center tap (or coil common wire) is connected to a separate common terminal. For signal lights, the switch coils are replaced by lamps or LED's. For stall motor switch machines, the motor is wired between the two outputs without using the common terminal.



An LED on the circuit card illuminates when DCC packets are received, and a separate LED illuminates for each phase of each output when active. This lets you easily see what the decoder is doing and if it is responding to your DCC data.

There is a provision for powering the unit from the track DCC or from an auxiliary DC power supply. A jumper must be in place for powering from DCC, while it must be removed to operate from an auxiliary DC supply. Not that this is the only unit that requires DC as an auxiliary power source.

A nice feature of the SM-104 is that the components that actually carry the load current are in sockets. If you destroy an output by overloading it, you can replace the switch transistor chip and be up and running again.

Connections: Track and output connections to the SM-104 are by screw clamp terminal strips except for the manual switch control inputs. These inputs are simply pins mounted into the printed wiring board. It is unclear how to connect to them other than soldering wires, which is inconvenient if you need to remove the unit for repair or reprogramming. There may be a mating connector, but it is not mentioned in the manual.

Feedback: The SM-104 has no provision for feedback to the cab bus. If you need switch position feed back, then you must wire the switch position data into an auxiliary cab bus input such as the NCE/Wangrow AIU-01.

Programming: The SM-104 must be programmed on the programming track before you install it. It is relatively easy to set up. You write a value to two CV's to set the base decoder address. You write a value to each of four CV's to set the function of the four outputs. Basically, program 6 CV values and you are ready to install and operate. The PR1 could not read the SM-104, but could program it in the CV programmer mode. The NCE Powerhouse could read and write CV values with no problem.

Manual: I found the manual poorly written and difficult to follow. The drawing in the manual did not match my unit, and the lines indicating connection points ended between terminals. I had to spend quite some time tracing wires on the printed wiring board to make sure that I was connecting things properly. Starting from E1, the terminal order on my unit was: +DC, Blank, -DC, Blank, DCC, DCC.

Performance: I was disappointed to find that one side of the number 3 output of my test sample did not operate at all. The other outputs appeared to operate correctly.

The SM-104 was able to operate the Tortoise switch machine with no problem. I measured 9.8 volts run and 8.6 volts stall using 10.6 volts external DC. I measured 10.7 volts run and 10.5 volts stall when operating from DCC. Performance was solid with good torque.

The SM-104 was not able to operate the New Jersey International switch machine on either DCC or external DC. The Peco dual coil unit functioned fine with good force on both DCC and external DC.

The grain-of-wheat lamps performed fine on both DCC and external DC. I measured 11.9 volts from DCC and 10.0 volts when using a 10.6 volt external source. This is good since there was little variation from DCC to external power.

The SM-104 really scored on the accessory motor. I measured 10.7 volts at 430 ma. It had no trouble with this load at all.

Recommendation: The SM-104 is a **BEST CHOICE** for driving auxiliary motors such as found in accessories or turntables. This is the only unit that was able to operate my accessory motor, and it was able to operate it with authority. It is a next best choice for stall motor switch machines. It operates well with these units without external components and provides the convenience of four outputs in one location. It is, however, more expensive per output than the Switch-It and must be moved to the programming track to change the decoder address. If you are using dual coil switch machines such as the Peco, the SM-104 will work well with them.